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Job Progress Report

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Title: Mid-Missouri Reservoirs Study

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ABSTRACT

Baseline limnological and fisheries data was gathered on Canyon Ferry, Hauser and Holter reservoirs to obtain a better understanding of fish population dynamics in the reservoirs and to evaluate impacts of existing reservoir operations on the sport fisheries.

Surface water temperatures (to 15 feet) were similar in Hauser and Holter reservoirs, but were warmer in Canyon Ferry Reservoir. The zooplankton community in Canyon Ferry Reservoir was dominated by Daphnia, Diaptomus and Cyclops spp. Seasonal differences in zooplankton densities were greater than differences among sampling stations.

Daphnia was the most important food item consumed by rainbow trout and yellow perch in the reservoir complex. Daphnia and Leptodora were the most important food items consumed by kokanee. Fish comprised 99% of the dietary volume found in walleye stomachs, with yellow perch being the most important forage species.

Salmonids dominated the catch in floating gill nets in all three reservoirs. Suckers and yellow perch dominated the catch in sinking gill nets. Rainbow trout dominated vertical net catches in Canyon Ferry and Holter reservoirs. Suckers, followed by kokanee, dominated vertical net catches in Hauser Reservoir.

Brown trout spawners were collected in three tributaries to Canyon Ferry Reservoir and three tributaries to Hauser Reservoir. Rainbow trout spawners were collected in Confederate, Duck, Magpie and Beaver creeks. Nineteen percent of rainbow spawners collected in tributaries to Canyon Ferry Reservoir were identified as Desmet strain. Emigration of brown trout fry was monitored in Trout and Confederate creeks. Kokanee fry were collected from Trout Creek.

Creel census indicated rainbow trout and yellow perch dominated the catch in the reservoir complex during the summer. Catch rates for rainbow trout averaged 0.28, 0.26 and 0.34 fish per hour in Canyon Ferry, Hauser and Holter reservoirs, respectively. Yellow perch dominated the catch during the 1986-87 ice fishery on Canyon Ferry Reservoir. Estimates of fall fishing pressure and harvest on three sections of the Missouri River are presented.

Catchability of Desmet rainbow in Canyon Ferry Reservoir was less than for Arlee rainbow during the summer, but appeared similar during the winter. Food habits were similar between strains. Monthly growth rates for Arlee and Desmet rainbow in Canyon Ferry Reservoir averaged 0.83 and 0.60 inches, respectively. Retention of fluorescent pigment marks over a six month sampling period approached 100%.

PLEASE RETURN

Recovery of marked reservoir trout indicated a low rate of escapement from the reservoirs during 1986. Rainbow trout flushed from the reservoirs tended to remain in the tailrace areas. The relatively low rate of escapement from Canyon Ferry Reservoir appeared to be correlated with the brief duration and limited magnitude of radial gate spills.

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OBJECTIVES AND DEGREE OF ATTAINMENT

Job Objectives

1. To maintain densities of rainbow trout in Canyon Ferry and Holter reservoirs and densities of rainbow trout and/or kokanee in Hauser Reservoir based on an index of abundance of an average of 15 yearling or older fish captured per 125 feet experimental gill net set during the spring.

2. To quantify downstream escapement of hatchery reared rainbow trout from the three reservoirs.

3. To monitor distribution and food supply of sport fishes in the three reservoirs.

4. To identify extent of natural reproduction occurring in the reservoir complex and identify areas where reproduction could be enhanced.

5. To provide for a stable salmonid fisheries with an average catch rate of 0.30 fish/hour in Canyon Ferry Reservoir and 0.40 fish/hour in Hauser and Holter reservoirs.

6. To provide for an average winter catch rate of 2.0 yellow perch/hour with an average size of 8.5 inches and an annual harvest of 300,000 in Canyon Ferry Reservoir.

7. To determine status of walleye populations in Hauser and Holter reservoirs.

8. To maintain requested instream flows in the Missouri River and minimize the loss of fish over mid Missouri River Dams during spill periods.

Degree of Attainment

Progress was accomplished on all objectives. This report emphasizes work involving objectives 2, 3, 4, 5 and 6. Findings are presented in appropriate sections of this report.

DESCRIPTION OF STUDY AREA AND METHODS

The study area has been previously described by Berg and Lere (1983), MDFWP (1985) and Rada (1974).

Water temperature and transparency were measured at permanent sampling stations established on each of the three reservoirs (Figures 1 and 2). Temperature was measured to the nearest 0.5° F at three foot intervals using a hydrographic thermometer. Water transparency was measured to the nearest 0.5 foot using a 20 cm. diameter Secchi disc.

Zooplankton densities were determined at permanent sampling stations using a conical plankton net (1 foot diameter). Vertical tows were made bi-weekly at each of the sampling stations from July through October. At stations of appropriate depth, tows measured 45 feet in length. At shallower stations, the length of tow covered the entire water column. Procedures used to process zooplankton samples followed those described by Leathe and Graham (1982).

Fish for food habit analyses were collected by gill netting or creel census activities. Stomach contents were removed in the field and placed in plastic vials with 10% formalin as preservative. Insects were identified to order and zooplankton were identified to genus. The number and volume of each identified food item were recorded. Subsamples of zooplankton were taken when large quantities were present in the diet. An index of relative importance was calculated by incorporating the number, volume and frequency of occurrence of a specific food item (George and Hadley 1979).

All rainbow trout planted in the reservoir complex during 1986 were marked with either fluorescent pigment or a fin clip. Techniques used in spray marking followed those described by Phinney and Mathews (1973) and Pribble (1976). To evaluate retention of pigment marks, all sprayed fish were also marked with tetracycline. Table 1 presents the marking scheme used during 1986. Rainbow trout collected from gill netting, electrofishing and creel census activities were examined in a viewing box under black light to identify fluorescent pigment marks. Vertebrate were removed from selected samples of rainbow trout and viewed under black light to examine for tetracycline marks.

Table 1. Marking scheme for rainbow trout planted in the reservoir complex during 1986.

Reservoir	Rainbow Strain	Number Planted	Pigment Color	TM[1]	Fin Clip
Canyon Ferry	Arlee	875,000	Red	Double	
	Desmet	80,000	Green	Single	
Hauser	Arlee	200,000			Adipose
Holter	Arlee	325,000	Orange	Single	
	McConaughy	35,000			Left Pelvic

[1] tetracycline mark

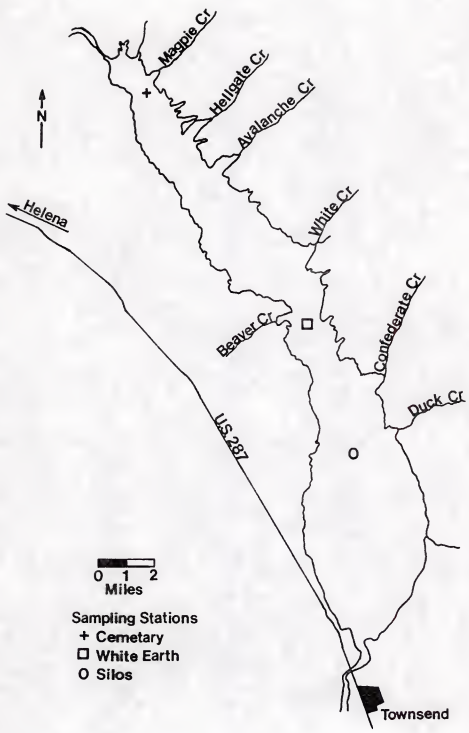


Figure 1 Map of Canyon Ferry Reservoir showing locations of permanent sampling stations.

Figure 2 Map of Hauser and Holter reservoirs showing locations of permanent sampling stations.

Reservoir fish were sampled with floating and sinking 6 x 125 foot experimental gill nets (3/4 to 2 inch mesh) set during the spring and fall. Distribution of fish species by depth was determined by using a bank of four vertical gill nets that were 150 feet deep and 12 feet wide (3/4, 1, 1¼ and 1½ inch mesh). Vertical nets were set monthly from July through September at permanent sampling stations located in the lower end of each reservoir.

A gas powered backpack electrofishing system was used to sample fish populations in the tributaries. Sex and spawning condition were recorded for adult fish captured during their spawning season. Trout larger than 10 inches in total length were marked with individually numbered anchor tags.

Drift nets (4.5 ft^2) were placed weekly in selected tributaries during the spring to filter fry from the water column in overnight sets. Holding boxes were used to reduce mortality. Streamflows were measured using standard U.S.G.S. techniques and water temperatures were monitored with maximum/minimum thermometers.

A boom suspended electrofishing system was used to sample fish populations in the tailwaters of the three reservoirs. The electrofishing system was adapted from Novotny and Priegel (1974). Population estimates were made using Chapman's modification of Peterson's mark and recapture formula (Ricker 1975).

A partial creel census was conducted on Canyon Ferry, Hauser and Holter reservoirs from mid April through October. This survey was conducted on all weekend days, all holidays and 2 randomly selected weekdays. Interviews were obtained by driving to as many access points as a 10 hour period allowed. Alternate reservoirs were sampled each census day. To further insure random coverage, starting points also were alternated each creel census day. Anglers were interviewed on an individual basis and the creel clerk kept a separate report for each interview conducted. An additional partial creel survey was conducted during the ice fishery on Canyon Ferry Reservoir from December 30 through March 4. This survey was conducted two days a week and included one weekend day and one week day.

A more comprehensive creel census was conducted on three sections of the Missouri River from late September through late November. These surveys were conducted to estimate fishing pressure and harvest on a three mile section of river located downstream from Toston Dam, the Canyon Ferry delta near Townsend, and the tailwater of Canyon Ferry Reservoir. Surveys were conducted on all weekend days, all holidays, and two randomly selected weekdays. Starting times for angler counts were selected randomly without replacement within 2 week strata. Procedures for these censuses were adapted from those described by Malvestuto (1983).

RESULTS

Physical Limnology

Canyon Ferry Reservoir

Temperatures of the surface waters (to 15 feet) in Canyon Ferry Reservoir averaged 63.7° F. during the sampling period and were similar among the three stations. A maximum average temperature of 69.8° F. was reached on August 11. A

thermocline was found to occur only at the Cemetery station and was present from July through mid September (Appendix Figures 1 and 2). The thermocline occurred at depths that ranged from 70 to 90 feet. Thermal stratification became less stable progressing up reservoir at successive stations.

Euphotic zone depths measured from July 23 to October 17 averaged 5.5, 6.2 and 8.6 feet, respectively, at the Silos, White Earth and Cemetery stations. Depth of the euphotic zone increased at successive stations from upper to lower end of the reservoir. This increase appeared to be reflective of the phytoplankton densities found in the reservoir.

Hauser Reservoir

Surface water temperatures (to 15 feet) in Hauser Reservoir were cooler than in Canyon Ferry Reservoir, averaging 58.4° F. during the sampling period. A maximum average temperature of 66.5° F. was reached on August 12. Surface water temperatures were approximately 1.0° F. warmer at the Causeway station than at the Lakeside or Dam stations. Higher temperatures found in the Causeway arm were likely due to the warming effect of shallow Lake Helena. A stable thermocline did not develop during the sampling period (Appendix Figure 3). This lack of thermal layering was probably the result of the run-of-the-river characteristics of the reservoir.

Euphotic zone depths measured from July 22 to November 6 averaged 5.9, 7.5 and 6.9 feet at the Lakeside, Causeway and Dam stations, respectively. These results were somewhat surprising since water in the Causeway arm tended to be warmer than other areas of the reservoir and was thought to be more productive. The depth of the euphotic zone was greatest at the Causeway station, however, indicating a lower phytoplankton density than at the other two stations.

Holter Reservoir

Surface water temperatures (to 15 feet) in Holter Reservoir were similar to those in Hauser Reservoir, averaging 58.9° F. during the sampling period. In addition, water temperatures were similar between sampling stations. A maximum temperature of 65.9° F. was reached on August 13. A stable thermocline did not develop during the sampling period (Appendix Figures 4 and 5). This lack of thermal layering, as in Hauser Reservoir, was likely due to the run-of-the-river characteristics of the reservoir.

Depth of the euphotic zone measured from July 22 to November 6 averaged 6.7 feet at the Cottonwood station and 8.9 feet at the Jackson station. Differences in euphotic zone depth appeared to be reflective of the phytoplankton densities found in the reservoir.

Zooplankton

Canyon Ferry Reservoir

The zooplankton community in Canyon Ferry Reservoir was dominated by *Daphnia*, *Diaptomus* and *Cyclops* spp. throughout most of the sampling period (Figure 3). *Bosmina* spp., *Leptodora* spp. and a member of Sididae comprised the remainder of the community, with *Bosmina* contributing significantly during the fall. *Daphnia* was the most numerous zooplankton, comprising an average of 37.5% of the

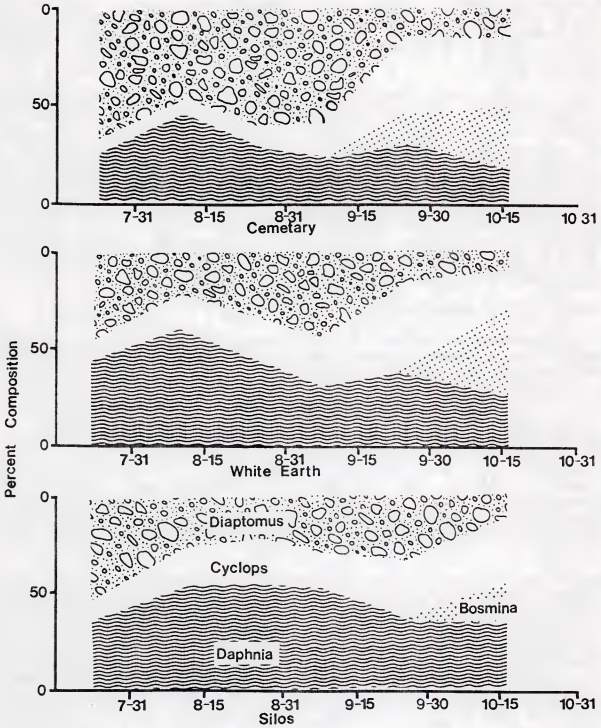


Figure 3 Species composition of principal zooplankton in upper (Silos), mid (White Earth), and lower (Cemetery) stations on Canyon Ferry Reservoir from July 23 to October 16, 1986.

zooplankton density. Diaptomus and Cyclops together comprised an average of 53.6% of the zooplankton population. Bosmina, first appearing in September, comprised as much as 43% of the community by mid October. Leptodora, an important food item for trout and perch, accounted for only 0.9% of the average plankton density.

Previous studies have shown zooplankton densities in Canyon Ferry Reservoir peak in May or June (Wright 1968). Since sampling in 1986 was begun in late July, the timing and magnitude of the spring plankton bloom could not be assessed. A secondary peak in zooplankton density, however, was observed to occur in mid August, with densities reaching as high as 17.7 organisms per liter (Figure 4). With the exception of the Cemetery station, zooplankton densities markedly declined in September and then increased again in October. At the Cemetery station, however, zooplankton numbers did not increase during October. The pattern of abundance for Daphnia, the major food item for rainbow trout, was similar to the pattern displayed by the entire zooplankton community. In general, seasonal differences in zooplankton densities were greater than differences found among sampling stations.

Hauser and Holter Reservoirs

Analyses of zooplankton samples taken in Hauser and Holter Reservoirs during 1986 have not been completed. These data will be presented in a future report when analyses are completed.

Food Habits

Rainbow Trout

A total of 666 rainbow trout stomachs were collected from the mid-Missouri Reservoir complex during 1986. Analysis of food habits was conducted on stomachs taken from 284, 198 and 184 rainbow trout collected in Canyon Ferry, Hauser and Holter reservoirs, respectively. A majority of rainbow trout stomachs were collected from fish captured in floating gill nets set during the spring and fall.

Approximately 5% of all rainbow trout stomachs collected were found to be empty. Daphnia was the most important food item consumed by rainbow trout in all three reservoirs, with IRI values ranging from 50 in Holter Reservoir to 67 in Canyon Ferry Reservoir (Figure 5). Leptodora was the next most important item consumed by rainbow trout in Canyon Ferry and Holter reservoirs. In Hauser Reservoir, aquatic dipterans was the second most important food category. Other food items in order of importance were coleopterans, hymenopterans, hemipterans and fish. Debris, including algae, sticks, rocks and cigarette butts, comprised a substantial portion of the stomach contents for rainbow trout, totaling 2, 32 and 21% of the volume in Canyon Ferry, Hauser and Holter reservoirs, respectively.

Yellow Perch

A total of 106 yellow perch stomachs were collected from the reservoir complex during 1986. Analyses of food habits were conducted on 49, 37 and 20 stomachs collected from Canyon Ferry, Hauser and Holter reservoirs, respectively. In Canyon Ferry and Holter reservoirs, a majority of yellow perch stomachs were

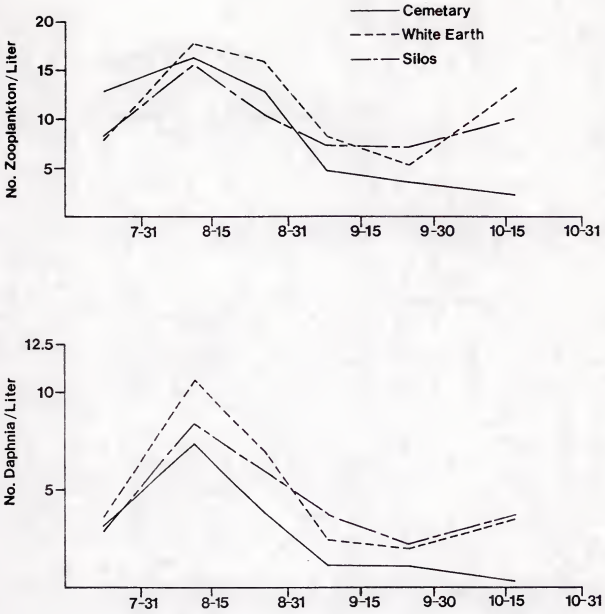


Figure 4 Densities (number per liter) of principal zooplankton (upper figure) and of Daphnia (lower figure) in three areas of Canyon Ferry Reservoir from July 23 to October 16, 1986.

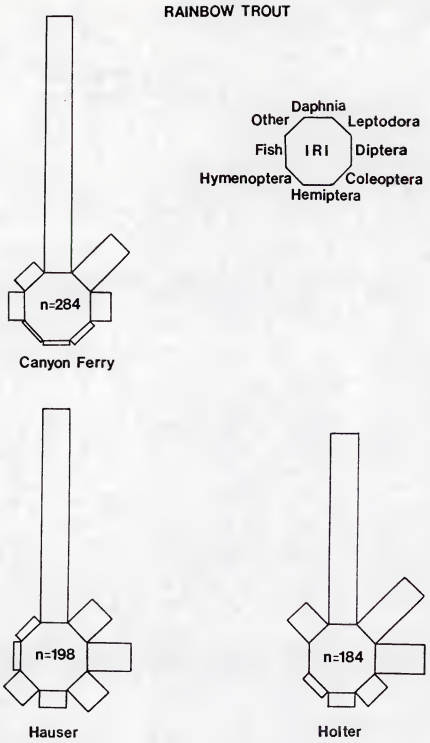


Figure 5 Indices of relative importance (IRI) for food items in the diet of rainbow trout collected from Canyon Ferry, Hauser and Holter reservoirs during 1986.

collected from fish captured in vertical gill nets during mid summer. In Hauser Reservoir, a majority of yellow perch stomachs were collected during creel census activities conducted in mid summer.

Twenty percent of all stomachs collected from yellow perch were found to be empty. Daphnia was the most important food item consumed in all three reservoirs, with IRI values ranging from 55 in Hauser Reservoir to 75 in Canyon Ferry Reservoir (Figure 6). The second most important food category was Leptodora and third was aquatic dipterans. Bandow (1969) also found Cladocera was the most important food item in the diet of yellow perch in Canyon Ferry Reservoir.

Kokanee

The stomachs from 155 kokanee in Hauser Reservoir and 24 kokanee in Holter reservoir were collected during 1986 for food habits analyses. Stomachs from kokanee in Hauser Reservoir were taken from fish collected in gill nets or creel census activities throughout the sampling period. In Holter Reservoir, a majority of kokanee stomachs were taken from fish collected in vertical gill nets during mid summer.

Nineteen percent of all stomachs collected from kokanee were found to be empty. Kokanee consumed primarily Daphnia, followed by Leptodora and aquatic dipterans (Figure 7). IRI values for Daphnia ranged from 67 in Holter Reservoir to 84 in Hauser Reservoir.

Brown Trout

A total of 59 stomachs were collected from brown trout in Canyon Ferry and Hauser reservoirs during 1986. Only 4 brown trout stomachs were collected in Holter Reservoir and, as a result, were not included in this summary. A majority of stomachs collected from brown trout were taken from fish captured in gill nets during the spring and fall.

Seventeen percent of all stomachs collected from brown trout were found to be empty. Fish was the most important food item consumed by brown trout in Canyon Ferry Reservoir, comprising 74% of the total dietary volume (Figure 8). In Hauser Reservoir, crayfish was the primary food item followed by fish, comprising 57 and 39%, respectively, of the total dietary volume. The IRI values appeared to overestimate the importance of zooplankton in the diet of brown trout when compared to fish and crayfish. Importance of these food items was overestimated because of the high frequency of occurrence, high numbers but low volume of zooplankton in relation to low numbers and high volume for fish and crayfish.

Walleye

A total of 36 stomachs were collected from walleye in Holter Reservoir during 1986. All stomachs were collected from fish captured in gill nets. Fifty-three percent of the stomachs were empty. Fish was the principal component in the diet of walleye, comprising 99% of the total dietary volume (Figure 9). Species of fish eaten by walleye, in order of importance, included yellow perch, rainbow trout and mountain whitefish. Similar to brown trout, IRI values overestimated the importance of zooplankton in the diet of walleye. Zooplankton comprised less than 0.1% of the dietary volume consumed by walleye, yet the IRI value was 25.

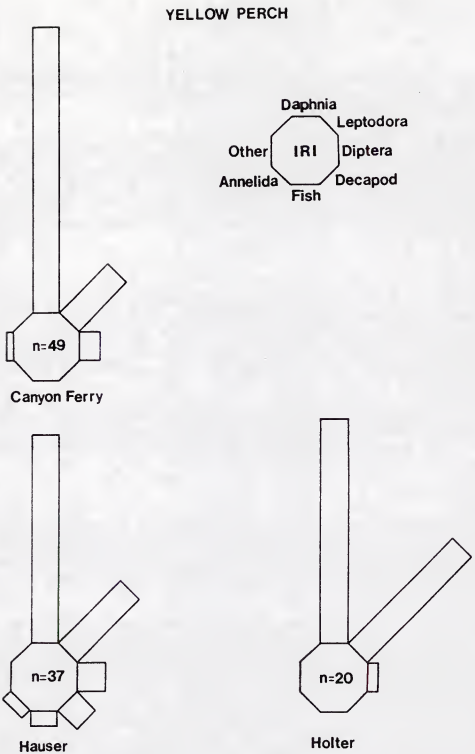


Figure 6 Indices of relative importance (IRI) for food items in the diet of yellow perch collected from Canyon Ferry, Hauser and Holter reservoirs during 1986.

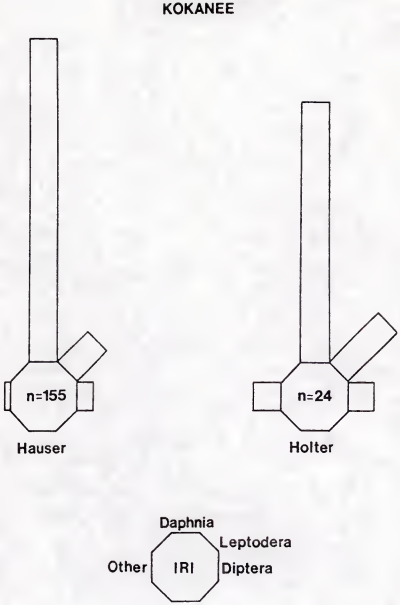


Figure 7 Indices of relative importance (IRI) for food items in the diet of kokanee collected from Hauser and Holter reservoirs during 1986.

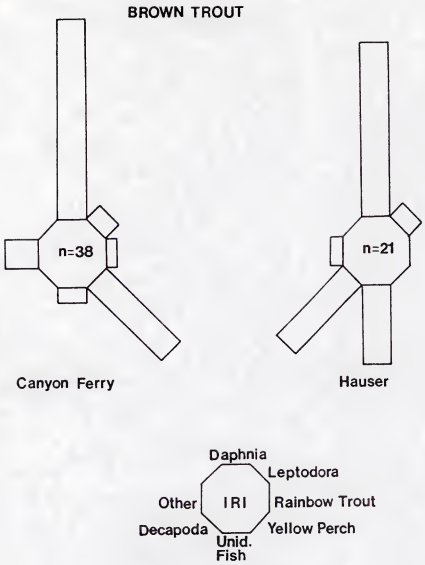


Figure 8 Indices of relative importance (IRI) for food items in the diet of brown trout collected from Canyon Ferry and Hauser reservoirs during 1986.

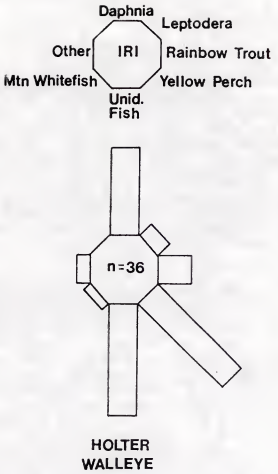


Figure 9 Indices of relative importance (IRI) for food items in the diet of walleye collected from Holter Reservoir during 1986.

Fish Abundance and Distribution

Canyon Ferry Reservoir

Horizontal Gill Nets

A total of 450 fish were collected in 31 floating gill nets set in Canyon Ferry Reservoir during 1986. Rainbow trout was by far the most abundant species captured in floating nets (91.1% of the catch), followed by brown trout, various rough fish and yellow perch (Table 2). Mean catch rates (fish per net) for rainbow trout varied both seasonally and by area (Figure 10). Catch rates during the spring were almost 3 times greater than during the fall (Appendix Table 1). In addition, there was a trend for catch rates to increase progressing up reservoir at successive stations. Floating gill nets have been used to monitor rainbow populations since 1983 (Rehwinkel 1986). Although sampling times have varied historically, a comparison of catch rates indicated rainbow abundance in 1986 had increased relative to previous years.

Table 2. Percent composition by species and net type for gill net catches in Canyon Ferry, Hauser, and Holter reservoirs during 1986.

	CANYON FERRY		HAUSER		HOLTER	
Species[1]	Floating Nets	Sinking Nets	Floating Nets	Sinking Nets	Floating Nets	Sinking Nets
Rb	91.1	0.9	29.9	0.7	47.9	4.5
LL	6.4	0.6	1.1	0.7	0.4	0.2
Kok			23.9	0.7	2.5	0.4
MWF		0.2	1.8	3.7	2.8	1.1
YP	0.7	57.3	0.3	2.2		22.7
WE					7.0	2.6
LnSu	0.2	2.8	33.1	54.5	24.3	24.6
WSu		36.9	8.9	37.5	14.4	43.9
CP	0.9	0.2	0.3		0.7	
UC	0.7	1.1	0.7			
TOTAL FISH CAUGHT	450	458	728	678	284	537
NUMBER OF NETS	31	3	20	3	13	6

1 Rb = rainbow trout; LL = brown trout; Kok = kokanee; MWF = mountain whitefish; YP = yellow perch; WE = walleye; LnSu = longnose sucker; WSu = white sucker; CP = carp; and UC = utah chub.

Rainbow trout collected in nets during 1986 averaged 13.6 inches in total length and 1.11 pounds in weight. To document downstream escapement of stocked fish,

10% of all rainbow trout (Arlee and Desmet strains) planted in Canyon Ferry Reservoir from 1983 to 1985 were marked with a fin clip. The Arlee strain received left pelvic clips in 1983 and 1985 and right pelvic clips in 1984. The Desmet strain received adipose clips during each of the three years. With the exception of two small lots, the Arlee strain was planted from April through mid August and the Desmet strain was planted from late August through October (Rehwinkel 1986). During these years, the stocking rates were similar for both strains. Seven percent of all rainbow trout collected in floating gill nets during 1986 were marked with a fin clip and approximately twice as many marked Arlee rainbow were collected than Desmet rainbow. These data indicate stocks of Desmet from 1983 to 1985 were less successful entering the fishery than stocks of Arlee.

Since 1983, all rainbow trout planted in Canyon Ferry Reservoir have been marked with tetracycline. From 1983 to 1985, all stocked trout received a single tetracycline mark (TM). In 1986, the Arlee strain received a double TM and the Desmet strain received a single TM. In addition, the two strains were spray marked with fluorescent pigment during 1986, with the Arlee strain sprayed red and the Desmet strain sprayed green. In 1986, the Arlee were stocked as age O+ fish and the Desmet were stocked as age I+ fish.

Approximately 92% of all rainbow trout collected in gill nets were marked with tetracycline, indicating most rainbow trout in Canyon Ferry Reservoir are of hatchery origin. From examination for spray marks during fall netting, approximately 60% of all collected rainbow trout were either age O+ Arlee (red) or age 1+ Desmet (green). Of these, 52% were Arlee strain and 8% were Desmet strain (ratio of 6.5 Arlee to 1 Desmet). The ratio at which the two strains were stocked into the reservoir during 1986 was approximately 10 Arlee to 1 Desmet.

A total of 458 fish were collected from 3 sinking gill nets set during 1986, with yellow perch (57.3%) and white sucker (36.9%) being the two most dominant species in the catch (Table 2). These data were similar to results obtained in 1983 and 1984 (Rehwinkel 1986). Average catch per net night in sinking gill nets is given in Appendix Table 2.

Vertical Gill Nets

Rainbow trout dominated the vertical gill net catch at the Cemetery station (lower reservoir), comprising 73% of the total number of fish collected. Rainbow trout were distributed throughout the upper 80 feet of the water column during the months of July, August and September (Figure 11). Rainbow trout were generally found above the thermocline and appeared to prefer water temperatures between 63 and 70° F. Temperatures ranging from 63 to 68° F. are near the physiological optimum for growth in salmonids (Brett et al. 1969, Brockson and Bogge 1974).

Hauser Reservoir

Horizontal Gill Nets

A total of 728 fish were collected in 20 floating gill nets set in Hauser Reservoir during 1986. Longnose and white suckers were the most abundant fish captured in floating nets (42% of the catch), followed by rainbow trout (30%) and kokanee (24%) (Table 2). Mean catch rates (fish per net) for rainbow trout and

kokanee varied seasonally and by area (Figure 10). In general, catch rates for rainbow trout were greatest in the spring, while catch rates for kokanee were greatest in the fall (Appendix Table 1). In addition, catch rates tended to be greater in the lower reservoir than in other reservoir areas. A substantial catch of kokanee spawners in the upper reservoir during the fall, however, was the exception to this trend. Rainbow trout collected in nets during 1986 averaged 12.7 inches in total length and 0.88 pounds in weight. Kokanee averaged 16.0 inches in total length and 1.59 pounds in weight.

All rainbow trout planted in Hauser Reservoir during 1986 were marked with an adipose clip. Approximately 72% of the rainbow trout collected in the fall were missing this fin. These fish were age O+ Arlee that had originally been stocked in July. Only 1.3% (3 fish) of the annual gill net catch were rainbow trout (TM and/or spray marked) that had been originally planted in Canyon Ferry Reservoir and had passed over or through the dam.

A total of 678 fish were collected from 3 sinking gill nets set during 1986. Suckers dominated the catch, comprising 92% of the sample (Table 2). Although walleye are known to be present in Hauser Reservoir, none were collected in sinking nets during 1986. Average catch per net night in sinking gill nets is given in Appendix Table 2.

Vertical Gill Nets

Suckers dominated the vertical gill net catch at the Dam station (lower reservoir), comprising 44% of the total number of fish collected. Kokanee and rainbow trout were also important constituents of the catch, comprising 32 and 17%, respectively, of the sample. Rainbow trout were distributed in the upper 25 feet of the water column during all sampling months and were found in water temperatures ranging from 60 to 69° F. (Figure 11). Kokanee tended to be distributed in water deeper than 25 feet during July and August and were found distributed throughout the water column in September. Kokanee appeared to prefer water temperatures cooler than 62° F. Shepard (1984) found a similar temperature preference for kokanee in Libby Reservoir.

Holter Reservoir

Horizontal Gill Nets

A total of 284 fish were collected from floating gill nets set in Holter Reservoir during 1986. Rainbow trout dominated the catch, comprising 49% of the sample, followed by suckers (39%) and walleye (7%) (Table 2). Mean catch rates (fish per net) for rainbow trout varied seasonally and by area (Figure 10). In general, catch rates for rainbow trout were greater in the fall than in the spring and tended to be greatest in the lower reservoir when compared to other reservoir areas (Appendix Table 1). Rainbow trout collected in nets during 1986 averaged 13.7 inches in total length and 1.11 pounds in weight. Although annual gill net surveys have been conducted since 1979 on Holter Reservoir, data obtained in 1986 were not comparable because nets that have been used historically were dissimilar in size. Region 4 personnel are continuing their standard net series in Holter Reservoir to maintain the historic record.

From 1984 to 1986, all of the McConaughy strain planted in the free flowing section of Missouri River located upstream from Holter Reservoir were marked with

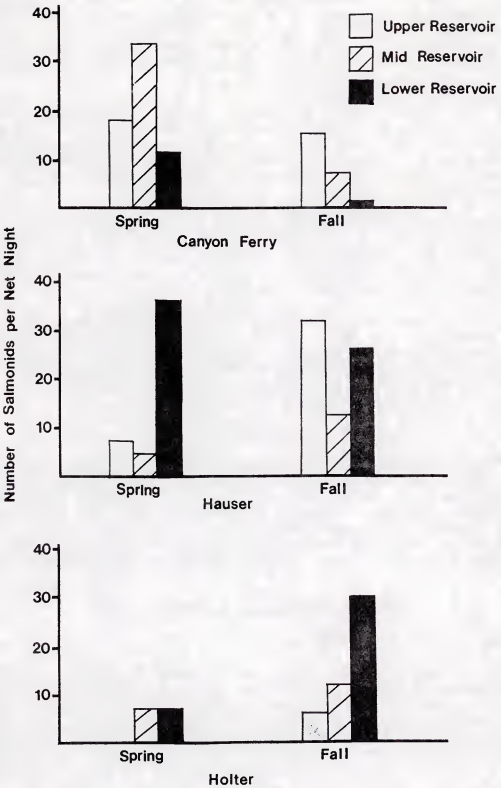


Figure 10 Seasonal catches of salmonids (number of fish per net night) in upper, mid and lower areas of Canyon Ferry, Hauser and Holter reservoirs during 1986.

a fin clip. These fish received adipose clips in 1984 and left pelvic clips in 1985 and 1986. Approximately 4% of the rainbow trout collected in gill nets during 1986 were marked with a fin clip. Evidently, only a few McConaughy rainbow have drifted downstream into Holter Reservoir. Most of these fish appear to have remained in the free flowing section of river where they were originally stocked.

In 1986, all Arlee rainbow planted in Holter Reservoir were marked with tetracycline (single TM) and spray marked with orange pigment. From examination for these marks, 59% of all rainbow trout collected during the fall were age O+ Arlee strain that had been planted in July. No marked fish originally planted in Canyon Ferry or Hauser reservoirs were collected from gill nets set in Holter Reservoir during 1986.

Catch rates for walleye in 1986 averaged 1.5 fish per floating net. Mean catches for walleye in years when similar net types were used have ranged from 1.2 fish per net (1969) to 2.8 fish per net (1974), indicating the walleye population has been relatively stable. Walleye collected in floating nets during 1986 averaged 19.0 inches in total length and 2.40 pounds in weight.

A total of 537 fish were collected from 6 sinking gill nets set during 1986. Suckers dominated the catch, comprising 69% of the sample, followed by yellow perch (23%) and rainbow trout (5%) (Table 2). Average catch per net night is given in Appendix Table 2. The catch rate for walleye averaged 2.3 fish per sinking gill net. The largest walleye collected measured 30.0 inches in total length and approximately 10.0 pounds in weight.

Vertical Gill Nets

Rainbow trout dominated the vertical gill net catch, comprising 50% of the sample. Yellow perch and kokanee were also important constituents of the catch comprising 20 and 17%, respectively, of the sample. Rainbow trout tended to be distributed in the upper 40 feet of the water column during all sampling months and were found in temperatures ranging from 58 to 69° F. (Figure 11). Kokanee tended to be distributed in water deeper than 45 feet during all sampling months. As in Hauser Reservoir, kokanee appeared to prefer water temperatures cooler than 62° F.

Salmonid Spawning in Tributaries

Brown Trout

The lower reaches of several tributaries to Canyon Ferry and Hauser reservoirs were electrofished during the fall, 1986 to document the possible presence of spawning runs. Numbers of brown trout captured in these tributaries are shown in Table 3. For tributaries to Canyon Ferry Reservoir, migrant brown trout were captured in Confederate, Beaver and Duck creeks. Of these three tributaries, Confederate Creek appeared to be the stream most utilized by brown trout spawners. However, extensive beaver dams located upstream from the mouth of Confederate Creek undoubtedly hinder the movement of migrant trout and utilization by spawners probably varies seasonally and from year to year depending upon the extent of dam construction.

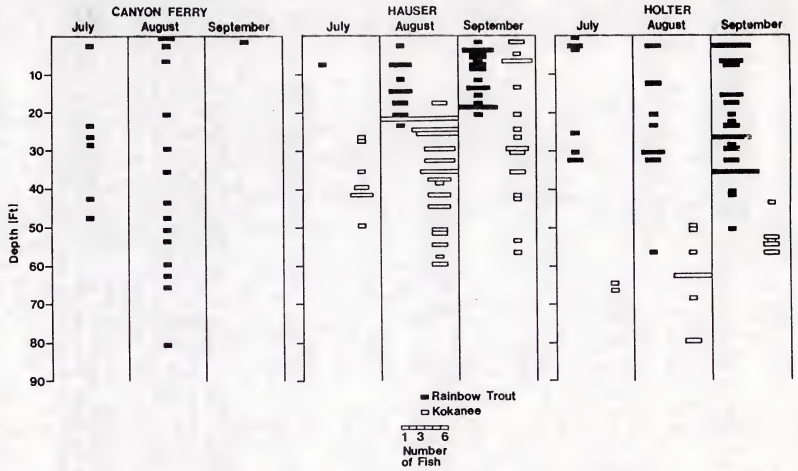


Figure 11 Vertical distribution of salmonids in Canyon Ferry, Hauser and Holter reservoirs as determined from vertical nets set during July, August and September, 1986.

Table 3. Number of brown trout sampled in tributaries to Canyon Ferry and Hauser reservoirs during the fall, 1986. Average length (inches) is in parentheses.

				Number of Brown Trout						
				Male		Female				
Reservoir	Tributary	Section Length(ft)	Date	Ripe	Spent	Gravid Ripe	Spent	Not Ripe	Immature	Total
Canyon Ferry	Confederate Cr.	500	10-1-86	0	0	0	0	0	42 (4.4)	42 (4.4)
			10-30-86	17 (19.7)	4 (21.4)	14 (16.8)	6 (19.2)	3 (9.0)	9 (3.9)	53 (15.8)
	Beaver Cr. (lower)	1,000	11-5-87	1	0	0	0	0	9 (4.5)	10
	Beaver Cr. (upper)	1,000	11-5-87	2 (11.3)	0	1 (16.3)	0	0	0	3 (12.9)
	Duck Cr.	500	10-2-87	0	0	1 (17.8)	0	1 (15.8)	36 (4.2)	38 (4.8)
	Duck Cr.	500	10-30-87	0	0	0	0	1 (10.4)	9 (4.4)	10 (4.9)
	Duck Cr. N. Channel	500	10-30-87	0	0	1 (13.4)	0	0	7 (3.6)	8 (4.8)
Hauser	Trout Cr. (mouth)	800	10-28-87	2 (18.5)	0	2 (19.4)	0	6 (10.3)	14 (5.7)	24 (9.1)
	Trout Cr. (lower)	500	10-31-87	14 (16.4)	1 (12.9)	14 (19.2)	2 (19.9)	5 (10.1)	4 (5.3)	40 (15.6)
	Trout Cr. (mid)	500	10-31-87	10 (14.2)	0	7 (11.0)	4 (14.5)	3 (9.6)	14 (5.8)	38 (10.2)
	Trout Cr. (upper)	900	10-31-87	13 (13.6)	0	3 (14.6)	0	7 (9.8)	5 (7.2)	28 (11.6)
	McGuire Cr.	900	10-31-87	15 (13.2)	0	2 (14.3)	2 (18.4)	2 (11.5)	24 (6.2)	45 (9.7)
	Silver Cr.	1,500	10-29-87	42 (14.9)	1 (17.0)	21 (17.0)	7 (18.9)	68 (9.0)	196 (5.4)	335 (8.3)

For tributaries to Hauser Reservoir, migrant brown trout were captured in Trout, McGuire and Silver creeks. Brown trout spawning runs in these three streams have been previously documented by Berg and Lere (1983). Trout Creek appeared to be the stream most utilized by brown trout spawners, with migrants being sampled as far as five miles above the confluence with Hauser Reservoir. A concrete diversion structure appeared to act as a barrier to migration beyond this point.

In addition to brown trout, kokanee migrants also were sampled in the three tributaries to Hauser Reservoir. Substantial numbers of kokanee migrants were observed spawning in the lower one mile of Trout Creek during 1986. This was the first year a kokanee spawning run has been documented in Trout Creek.

Rainbow Trout

To document the possible presence of rainbow trout spawning runs, several tributaries to Canyon Ferry Reservoir were electrofished during the spring, 1987

(Table 4). Rainbow spawners were sampled in Confederate, Duck and Magpie creeks. Approximately 19% of the spawners sampled in these streams were Desmet rainbow marked with pigment or with a fin clip. A majority of these marked fish were age II+ Desmet that had been planted in May, 1986.

Table 4. Number of rainbow trout sampled in Beaver Creek and tributaries to Canyon Ferry Reservoir during the spring, 1986. Average length (inches) is in parentheses.

				Number of Rainbow Trout						
				Male		Female				
Reservoir	Tributary	Section Length(ft)	Date	Ripe	Spent	Gravid Ripe	Spent	Not Ripe	Immature	Total
Canyon Ferry	Confederate Cr.	500	3-31-87	30 (16.3)	0	18 (17.6)	6 (18.0)	0	8 (5.2)	62 (15.4)
		1,200	4-10-87	58 (16.2)	0	19 (17.1)	12 (17.6)	6 (9.3)	27 (6.2)	122 (13.9)
	Duck Cr.	725	4-3-87	8 (16.1)	0	0	4 (17.9)	10 (9.9)	46 (6.2)	68 (8.6)
	Magpie Cr.	150	5-6-87	23 (13.9)	0	5 (16.3)	1 (16.1)	0	4 (5.4)	33 (13.3)
Holter/ Missouri R.	Beaver Cr.	1,000	4-6-87	8 (13.6)	0	0	0	9 (8.8)	111 (4.7)	128 (5.5)
			4-27-87	35 (15.7)	0	23 (17.7)	30 (17.9)	8 (9.9)	75 (4.7)	171 (11.2)

In addition to finding migrant rainbow spawners in the tributaries to Canyon Ferry Reservoir, migrant young of the year rainbow also were sampled. Approximately 70% of all immature rainbow trout collected in the tributaries were pigment marked hatchery fish. Of these, 62% were Arlee strain (red) and 8% were Desmet strain (green).

Beaver Creek, a tributary to the free flowing segment of Missouri River upstream from Holter Reservoir, also was electrofished in the spring, 1987 to identify potential spawning use by fin clipped McConaughy rainbow. A total of 96 rainbow spawners were collected from Beaver Creek. Approximately 44% of the migrants were McConaughy rainbow marked with a fin clip. A majority of these marked fish were age II+ McConaughy that were planted in September, 1985.

Fry Emigration Traps

Emigration traps were set in Confederate and Trout creeks during the spring, 1987 to determine the timing and abundance of fry recruitment of brown trout and kokanee to the reservoirs. In Confederate Creek, emigration of brown trout fry peaked in late April when water temperature warmed above approximately 40° F. (Figure 12). During this peak, an estimated 140 brown trout fry per night emigrated from the stream. In Trout Creek, emigration of both brown trout and kokanee fry peaked in late April (Figure 13). An estimated 530 brown trout fry and 50 kokanee fry per night emigrated from Trout Creek during this peak.

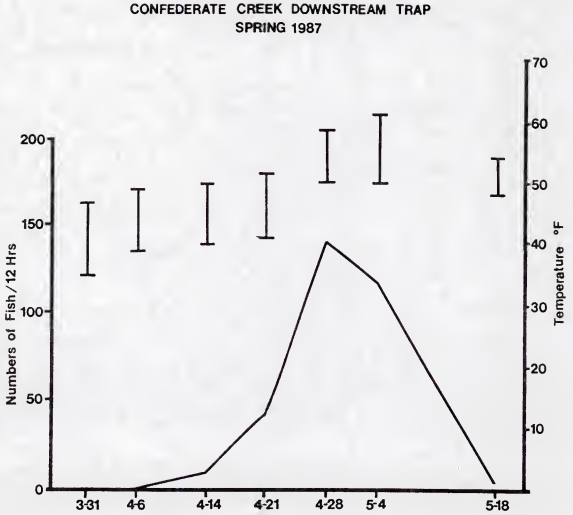


Figure 12 Estimated number of brown trout fry emigrating from Confederate Creek during the spring, 1986. Bars represent maximum/minimum thermometer readings.

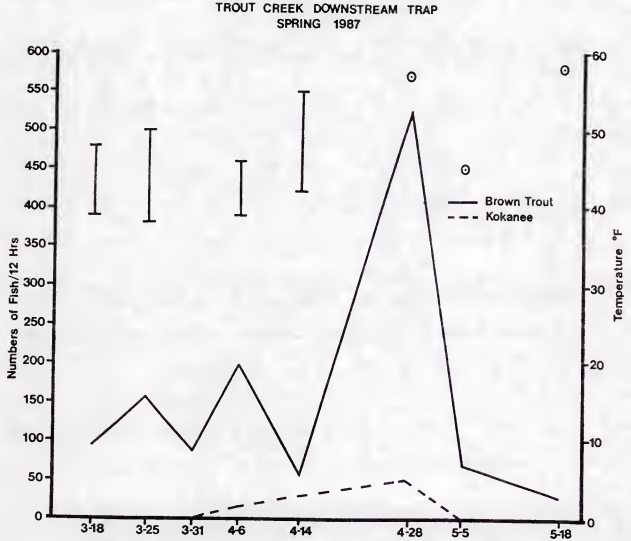


Figure 13 Estimated number of brown trout and kokanee fry emigrating from Trout Creek during the spring of 1986. Bars represent maximum/minimum thermometer readings and dots represent individual thermometer readings.

Interview Distribution, Party Size and Angler Day

A total of 3,999 anglers were interviewed on the mid-Missouri Reservoir complex during the summer, 1986. Interviews on Canyon Ferry, Hauser and Holter Reservoirs number 1532, 1404 and 1063, respectively (Table 5). Thirty-six percent of these interviews were conducted on weekdays and 64% were conducted on weekends (Table 6). The greater number of interviews on the weekends did not necessarily reflect fishing pressure but was more likely a result of the sampling schedule.

Table 5. Total number of angler interviews conducted on the mid-Missouri Reservoir complex during the summer, 1986 and their distribution by month.

Reservoir	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Canyon Ferry	112	241	204	238	201	207	247	82	1532
Hauser	54	288	226	323	293	146	74	0	1404
Holter	88	229	263	140	230	87	26	0	1063

Table 6. Distribution of angler interviews conducted on the mid-Missouri Reservoir complex during the summer, 1986 by day of the week.

Reservoir	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Canyon Ferry	201	123	116	81	139	438	434
Hauser	92	79	120	135	103	360	515
Holter	79	54	25	94	18	372	421

Anglers per party averaged 2.46, 2.98 and 2.43 on Canyon Ferry, Hauser and Holter reservoirs, respectively. Parties of up to 9 anglers were encountered. The length of an angler day averaged 3.64, 3.96 and 3.88 hours on the three respective reservoirs.

Characteristics of Anglers

Anglers fishing the reservoir complex tended to originate from populous counties located in the proximity of each reservoir (Table 7). On Canyon Ferry Reservoir, a majority of the anglers were from either Gallatin or Lewis and Clark counties. On Hauser Reservoir, most of the anglers resided in Lewis and Clark County and on Holter Reservoir a majority of anglers were residents of Cascade County. Only 5% of all anglers surveyed were from outside of Montana.

A majority of anglers interviewed on Canyon Ferry and Hauser reservoirs were fishing from shore, comprising 63 and 58% of the interviews, respectively. In contrast, 66% of the anglers interviewed on Holter Reservoir were fishing from a boat.

Bait fishing was the most popular method of fishing on all three reservoirs (Table 8). Lures or a combination of lure and bait was the second most popular fishing method. Fly fishing on the reservoirs was almost nonexistent.

On all three reservoirs, a majority of anglers indicated they were seeking to catch trout (Table 9). Approximately 80% of all anglers were fishing for rainbow trout. Yellow perch was the second most fished for species on Canyon Ferry and Holter reservoirs. On Hauser Reservoir, kokanee was the second most fished for species.

Table 7. Residency of anglers fishing the mid-Missouri Reservoir complex during the summer, 1986.

	PERCENT OF TOTAL						
Reservoir	Lewis & Clark	Cascade	Gallatin	Silver Bow	Other MT (East)	Other MT (West)	Non-Resident
Canyon Ferry	23	2	28	7	27	8	5
Hauser	62	6	2	4	7	13	6
Holter	3	63	1	<1	13	15	5

Table 8. Type of tackle used by anglers fishing the mid-Missouri Reservoir complex during the summer, 1986.

	PERCENT OF TOTAL			
Reservoir	Bait	Lures	Flies	Combo
Canyon Ferry	66	26	<1	8
Hauser	61	16	<1	22
Holter	45	29	1	25

Table 9. Species targeted by anglers fishing the mid-Missouri Reservoir complex during the summer, 1986.

Reservoir	PERCENT OF TOTAL						
	Trout	Trout & Kokanee	Kokanee	Yellow Perch	Trout & Perch	Other	Any Fish
Canyon Ferry	82	<1	0	13	2	0	3
Hauser	75	1	12	3	1	1	7
Holter	85	<1	<1	6	3	1	5

Composition of Catch and Catch Rates for Canyon Ferry Reservoir

Rainbow trout and yellow perch were the most readily caught species from Canyon Ferry Reservoir, comprising 43 and 55%, respectively, of the catch (Table 10). A summary of monthly catch rates is presented in Table 11. The overall catch rate for rainbow trout was 0.28 fish per hour and anglers kept 83.3% of all rainbow trout landed. This catch rate was 2.5 times greater than the catch rate determined for 1983 (Rehwinkel 1986). Better fishing in 1986 may be a result of the past two consecutive years where spill was low or nonexistent. Population levels of trout in the reservoir appear to be negatively correlated to the magnitude and duration of spills over the dam. This relationship also has been found to occur on Holter Reservoir (Hill 1973). Catch rates for rainbow trout ranged from a low of 0.14 fish per hour in July to a high of 0.54 fish per hour in November. Improved catch rates beginning in August were partially the result of the entry of 1986 spring plants into the fishery. The overall catch rate for yellow perch was 0.37 fish per hour with greatest rates occurring during July and August. Anglers kept 92.5% of all yellow perch landed.

Table 10. Composition of catch on the mid-Missouri Reservoir complex during the summer, 1986.

Reservoir	Number Caught	% COMPOSITION OF CATCH					
		Rainbow Trout	Brown Trout	Kokanee	Walleye	Smallmouth Bass	Yellow Perch
Canyon Ferry	3145	42.6	2.0	--	--	--	55.4
Hauser	2221	52.9	0.9	19.8	0	0.2	26.2
Holter	1893	67.5	0.3	1.0	0.4	--	30.8

Table 11. Monthly catch rates (fish per hour) on Canyon Ferry Reservoir during the summer, 1986.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Yellow Perch Caught
April	112	352.8	0.24	0.02	0
May	241	887.4	0.30	0.04	0.05
June	204	564.4	0.20	0.01	0.33
July	238	809.6	0.14	0	0.78
August	201	605.5	0.41	0.01	0.78
September	207	625.9	0.24	<0.01	0.54
October	247	650.7	0.34	<0.01	0.10
November	82	282.0	0.54	0	0.02
Total	1532	4778.3	0.28	0.01	0.37

In all cases, anglers seeking to catch a certain species were more successful catching that preferred species than were other angler groups. Boat fishermen were more successful catching rainbow trout than shore anglers, landing 0.17 more fish per hour. In contrast, shore anglers were more successful catching yellow perch than boat fishermen, landing 0.30 more fish per hour.

Characteristics of Game Fish Harvested in Canyon Ferry Reservoir

The length frequency distribution for 877 rainbow trout harvested from Canyon Ferry Reservoir during the summer, 1986 is shown in Figure 14. Distribution of lengths was bell-shaped and discrete age classes were not distinguishable. Harvested rainbow trout averaged 14.9 inches in total length and 1.40 pounds in weight. Length ranged from 7.3 to 24.4 inches and weight ranged from 0.13 to 4.80 pounds. Length data was also gathered from 50 harvested brown trout. These fish averaged 17.4 inches in total length and 1.90 pounds in weight. The age composition of harvested trout has not been analyzed because aging from scale samples is incomplete. These data will be presented in a future report when scale analyses are completed.

Table 12 presents a summary of fin clipped rainbow trout harvested from the reservoir during the summer, 1986. Although the average stocking rate was similar for both the Arlee and Desmet strains during the years (1983-1985) when 10% of the plant was fin clipped, the harvest during 1986 contained substantially fewer marked Desmet than Arlee. Apparently, the fall plants of Desmet were less

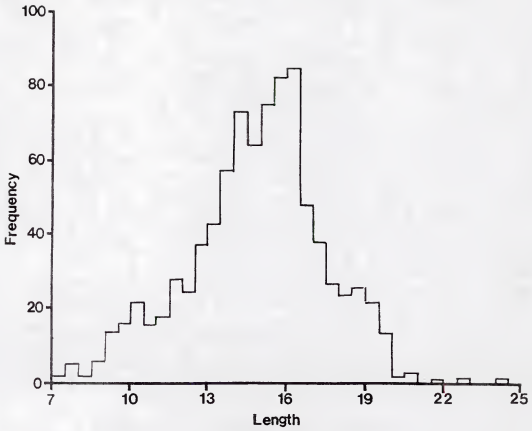


Figure 14 Length frequency distribution of rainbow trout har
from Canyon Ferry Reservoir during the summer, 1986.

successful than the spring plants of Arlee and/or the catchability of the Desmet strain was less than the Arlee strain.

Table 12. The number and mean total length of the fin clipped rainbow trout harvested from Canyon Ferry Reservoir during the summer, 1986.

Strain	Year Planted	Fin Clip	Number Harvested	x Length (Inches)
Arlee	1983&1985	Left Pelvic	70	15.5
	1984	Right Pelvic	5	18.2
Desmet	1983-1985	Adipose	4	13.9

A summary of tetracycline and pigment marked rainbow trout harvested from the reservoir is presented in Table 13. Approximately 97% of the rainbow trout examined for tetracycline marks were found to be positive, indicating a hatchery origin. Apparently, recruitment of rainbow trout from the tributaries (and Missouri River) to Canyon Ferry Reservoir is extremely limited. From examination for fluorescent spray marks, approximately 19% of the rainbow harvest was comprised of age 0+ Arlee or age I+ Desmet that were stocked into the reservoir during May, 1986. Of these, 18% were Arlee strain (red marks) and 1% were Desmet strain (green marks). The Arlee were first observed entering the creel in June while the Desmet first entered the creel in August. Survivability and/or catchability appeared to be less for the Desmet strain than the Arlee strain since the harvest ratio (17 Arlee to 1 Desmet) was greater between the two strains than the ratio at which they were stocked into the reservoir (10 Arlee to 1 Desmet).

Table 13. The number of tetracycline (TM) and pigment marked rainbow trout harvested from Canyon Ferry Reservoir during the summer, 1986.

TM Mark	Number Harvested*	Percent of Total	Pigment Mark	Number Harvested	Percent of Total
None	22	3.4	None	714	81.4
Single	504	78.3	Green	9	1.0
Double	118	18.3	Red	154	17.6
Total	644	100.0		877	100.0

* 233 harvested rainbow trout were not examined for TM marks.

Composition of Catch and Catch Rates for Hauser Reservoir

Rainbow trout, yellow perch and kokanee were the most readily caught species in Hauser Reservoir, comprising 53, 26 and 20% of the catch, respectively (Table 10). A summary of monthly catch rates is presented in Table 14. The overall catch rate for rainbow trout was 0.26 fish per hour with rates ranging from 0.14 fish per hour in July to 0.95 fish per hour in October. Higher fall catch rates were, in part, reflective of the entry of 1986 summer planted trout into the fishery. Anglers kept 88.7% of all rainbow trout landed. The overall catch rate for kokanee, excluding the fall fishery in the Canyon Ferry tailrace, was 0.10 fish per hour with greatest rates occurring in July and August. Anglers kept 98.6% of all kokanee landed. The catch rate for yellow perch averaged 0.13 fish per hour and anglers kept 79.2% of all perch landed. Catch rates for yellow perch were greatest in August and September.

Table 14. Monthly catch rates (fish per hour) on Hauser Reservoir during the summer, 1986.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Kokanee Caught	Yellow Perch Caught
April	54	126.0	0.19	0.02	0.02	0.02
May	288	990.9	0.40	<0.01	0.03	0.01
June	226	607.5	0.15	<0.01	0.05	0.06
July	323	987.5	0.17	0.01	0.17	0.10
August	293	1188.7	0.10	<0.01	0.16	0.27
September	146	477.7	0.46	<0.01	0.03	0.23
October	74	176.4	0.95	0	0.01	0.07
Total	1404	4554.7	0.26	<0.01	0.10	0.13

Boat and shore anglers were equally successful in catching rainbow trout in Hauser Reservoir. Boat anglers, however, were more successful in landing kokanee than shore fishermen, catching 0.17 more fish per hour. In contrast, boat anglers were less successful in catching yellow perch than shore anglers.

Characteristics of Game Fish Harvested in Hauser Reservoir

The length frequency distribution for 826 rainbow trout harvested in Hauser Reservoir during the summer, 1986 is presented in Figure 15. One distinct age class was visible in the distribution. Age O+ trout were distributed around a length of 10.0 inches while age I+ and older trout were distributed around a 13.5 inch mode. Harvested rainbow trout averaged 13.5 inches in total length and 1.06

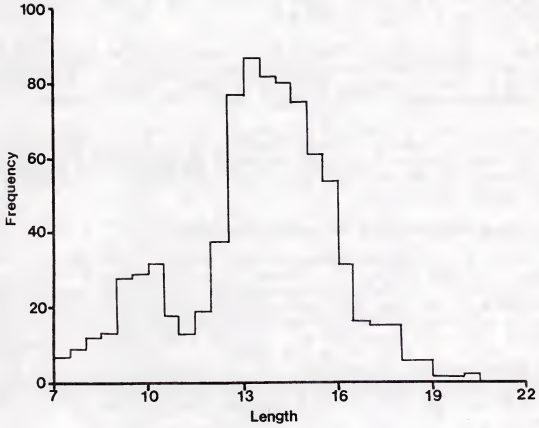


Figure 15 Length frequency distribution of rainbow trout harvested from Hauser Reservoir during the summer, 1986.

pounds in weight. Length ranged from 7.0 to 20.1 inches and weight ranged from 0.14 to 4.06 pounds.

All rainbow trout planted in Hauser Reservoir during 1986 were marked with an adipose fin clip. From examination for these marks, 18% of the summer harvest was comprised of age 0+ rainbow trout (clipped adipose) that had been planted in July. These plants, averaging 9.6 inches in total length, were first observed entering the creel in August. Approximately 3.5% of the summer harvest were trout (TM and/or spray marked) that had been originally planted in Canyon Ferry Reservoir and had passed over or through the dam. A majority of these fish were harvested from the Canyon Ferry tailrace.

The length frequency distribution for 366 harvested kokanee was bell-shaped and discrete age classes were not distinguishable (Figure 16). Harvested kokanee averaged 16.6 inches in total length and 1.86 pounds in weight. The largest kokanee measured was 22.2 inches in length and 3.94 pounds in weight.

Length data also was gathered from 16 harvested brown trout. These fish averaged 17.1 inches in total length and 2.29 pounds in weight. Additionally, 3 harvested smallmouth bass averaged 12.4 inches in length and 1.16 pounds in weight. Age composition analyses of harvested fish will be presented in a future report when aging of scales is completed.

Composition of Catch and Catch Rates for Holter Reservoir

Rainbow trout and yellow perch were the most readily caught species in Holter Reservoir, comprising 68 and 31% of the catch, respectively (Table 10). A summary of monthly catch rates is presented in Table 15. The overall catch rate for rainbow trout was 0.34 fish per hour with rates ranging from 0.18 fish per hour during August to 1.66 fish per hour during October. As in Hauser Reservoir, the greater fall catch rates were reflective of 1986 summer plants entering the fishery. Anglers kept 81.8% of all rainbow trout landed. Catch rates for rainbow trout during 1986 were similar to catch statistics obtained during 1970 and 1971 (Hill 1973). The overall catch rate for yellow perch was 0.16 fish per hour with the greatest rate occurring in August. Anglers kept 91.3% of all perch landed.

Table 15. Monthly catch rates (fish per hour) on Holter Reservoir during the summer, 1986.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Kokanee Caught	Yellow Perch Caught
April	88	334.9	0.30	0	0	0
May	229	936.1	0.31	<0.01	<0.01	0.06
June	262	979.2	0.31	0	0.01	0.17
July	140	455.8	0.29	<0.01	0.01	0.18
August	230	717.5	0.18	<0.01	0.01	0.34

Table 15. (Cont.)

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Brown Trout Caught	Kokanee Caught	Yellow Perch Caught
September	87	252.4	0.76	0	<0.01	0.12
October	26	80.5	1.66	0	0	0
Total	1063	3759.9	0.34	<0.01	0.01	0.16

Boat anglers were more successful in landing rainbow trout than shore anglers, catching 0.10 more fish per hour. In contrast, shore anglers were more successful landing yellow perch, catching 0.20 more fish per hour than boat fishermen.

Characteristics of Game Fish Harvested in Holter Reservoir

The length frequency distribution of 864 rainbow trout harvested from Holter Reservoir during the summer, 1986 is presented in Figure 17. One distinct age class (age 0+) is visible in the distribution at a length of 10.0 inches. Harvested rainbow trout averaged 13.9 inches in total length and 1.17 pounds in weight. Length ranged from 8.1 to 20.8 inches and weight ranged from 0.22 to 4.44 pounds.

From examination for orange spray marks, 11.5% of the 1986 summer harvest were age 0+ Arlee rainbow trout that were planted in July. These marked fish, averaging 9.9 inches in total length, were first observed entering the creel in August. From examination for fin clips, only 6 marked McConaughy strain were harvested during the summer, 1986. Five of these fish were 1984 planters that averaged 15.5 inches in total length. The remaining fin clipped fish was a 1985 planter that measured 12.8 inches in total length.

Length data also was gathered on 19 kokanee, 5 brown trout and 6 walleye harvested from the reservoir. The kokanee averaged 16.9 inches in total length and 2.17 pounds in weight with the the largest measuring 20.1 inches and 3.01 pounds. Harvested brown trout averaged 17.7 inches in total length. Walleye averaged 15.0 inches in total length and 1.25 pounds in weight. Age composition data will be presented in a future report when aging of scales is completed.

Canyon Ferry Winter Creel Census (1986-87)

Distribution of Interviews and Angler Characteristics

A total of 951 anglers were interviewed on Canyon Ferry Reservoir during the 1986-87 ice fishery. Interviews during December, January, February, and March numbered 53, 550, 277 and 71, respectively. Thirty-three percent of the interviews were conducted on weekdays and 67% were conducted on weekends. This distribution is probably an actual reflection of fishing pressure during the winter ice fishery.

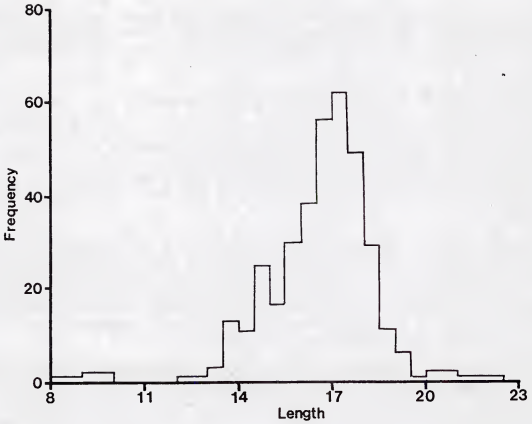


Figure 16 Length frequency distribution of kokanee harvested from Hauser Reservoir during the summer, 1986.

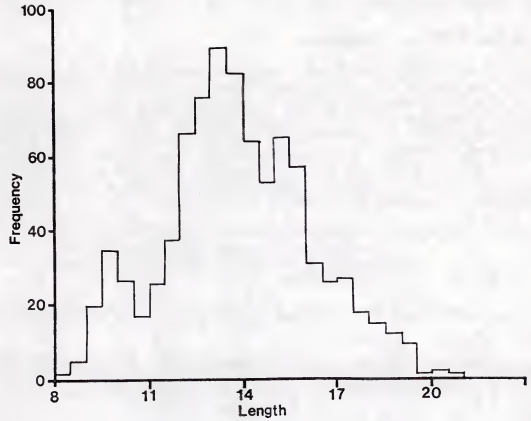


Figure 17 Length frequency distribution of rainbow trout harvested from Holter Reservoir during the summer, 1986.

A majority of the anglers interviewed were residents of either Lewis and Clark (27%), Gallatin (26%), or Broadwater (12%) counties. Less than 1% of the anglers surveyed were from out-of-state. Approximately 79% of all anglers on the reservoir were found to be fishing from the Silos area south to the dust abatement ponds. Forty-nine percent of all anglers interviewed were seeking to catch either trout or perch, while 25% were fishing specifically for perch and 20% were fishing specifically for trout.

Composition of Catch and Catch Rates

Yellow perch and rainbow trout were the most readily caught species on Canyon Ferry Reservoir during the winter, comprising 90 and 9.8%, respectively, of the catch. A summary of monthly catch rates is presented in Table 16. The overall catch rate for rainbow trout was 0.25 fish per hour and anglers kept 98% of all rainbow trout landed. This catch rate was approximately 2 times greater than the catch rates determined for 1983 and 1985-86 (Lere 1986). The overall catch rate for yellow perch was 2.29 fish per hour and anglers kept 98% of all yellow perch landed. This catch rate was approximately 1.4 fish per hour less than the catch rate obtained during the winter of 1985-86.

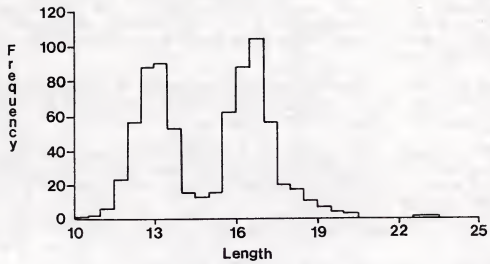
Table 16. Monthly catch rates (fish per hour) from Canyon Ferry Reservoir during the winter, 1986-87 with comparable rates obtained in 1985 and 1985-86.

	1986-87		Rainbow Trout Caught			Yellow Perch Caught		
Month	Number of Anglers	Hours Fished	1986-87	1985-86	1983	1986-87	1985-86	1983
December	53	246.4	0.14	0.12	0.20	2.28	3.85	1.88
January	550	1974.3	0.21	0.10	0.13	2.33	2.91	0.90
February	277	978.0	0.35	0.14	0.14	2.03	3.59	1.06
March	71	207.3	0.29	0.06	0.10	3.17	7.68	0.06
Total	951	3406.0	0.25	0.11	0.13	2.29	3.68	0.79

Anglers seeking to catch a certain species were more successful catching that species than were other angler groups. Anglers fishing for trout caught 0.35 more trout per hour than did perch fishermen. In contrast, perch fishermen caught 2.83 more perch per hour than did trout anglers. Anglers fishing for both trout and perch tended to have intermediate catch rates for both species.

Characteristics of Harvested Fish

The length frequency distribution for 733 rainbow trout harvested during the winter ice fishery is given in Figure 18. Two distinct age classes are visible in the distribution. Age I+ fish were distributed around a length of 13.0 inches and age II+ fish were distributed around a length of 16.5 inches. Harvested rainbow trout averaged 15.1 inches in total length and 1.38 pounds in weight.



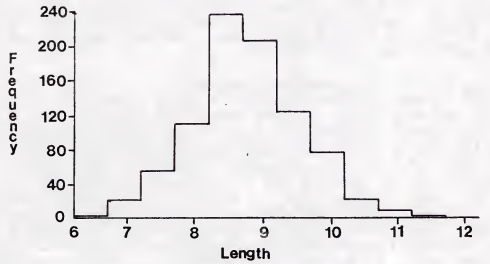


Figure 18 Length frequency distribution of rainbow trout (upper figure)and yellow perch harvested from Canyon Ferry Reservoir during the winter, 1986.

About 36% of the trout harvest was comprised of spray marked fish. The ratio of Arlee (red marked) to Desmet strain (green marked) in the harvest was similar to the ratio at which they were stocked into the reservoir (approximately 10 Arlee to 1 Desmet). The Arlee and Desmet strains, respectively, averaged 13.0 and 13.3 inches in total length.

Trout marked with a fin clip comprised approximately 5% of the harvest. A majority of these (3.7%) were Arlee strain that were planted in 1985. These Arlee averaged 16.6 inches in total length.

The length frequency distribution for harvested yellow perch is given in Figure 18. Distribution of lengths was bell-shaped and discete age classes were not distinguishable. Harvested yellow perch averaged 8.6 inches in total length and 0.31 pounds in weight.

Canyon Ferry Tailrace Creel Census (1986)

Distribution of Interviews and Angler Characteristics

A total of 380 anglers were interviewed on the Canyon Ferry tailrace from September 20 through November 28, 1986. The sampling schedule was stratified to allow for estimates of fishing pressure and harvest. Interviews numbered 41, 253 and 86 during September, October and November, respectively. Thirty-six percent of the interviews were conducted on weekdays and 64% were conducted on weekends.

Seventy percent of all anglers surveyed were residents of Lewis and Clark County. Out of state anglers comprised about 9% of the total interviews. Nearly all interviews were directed at shore anglers since creel clerks could interview boat anglers only when they returned to shore. Boat anglers comprised only 3% of those surveyed. Fifty-six percent of all anglers surveyed were seeking to catch trout while 35% were fishing for kokanee. Bait was the most popular fishing method, comprising 82% of all interviews.

Composition of Catch, Catch Rates and Harvest

Kokanee and rainbow trout were the most readily caught species in the Canyon Ferry tailrace, comprising 58 and 37% of the catch, respectively. A summary of monthly catch rates is presented in Table 17. The overall catch rate for kokanee was 0.30 fish per hour and anglers kept 86% of all kokanee landed. This catch rate was only one half the rate obtained during 1985 (Lere 1986). The lower catch rate in 1986 may have been due to the timing of the spawning run. Adult kokanee were found concentrated at the base of the dam one month earlier during 1986 than 1985 (August vs. September). As a result, the 1986 creel census may have missed a major part of the harvest by beginning in September instead of August. The overall catch rate for rainbow trout was 0.19 fish per hour and anglers kept 82% of all rainbow trout landed. This catch rate was about 0.50 fish per hour less than the catch rate obtained in 1985.

Although fishing pressure on the Canyon Ferry tailrace increased 60% between 1985 and 1986, fewer kokanee and rainbow trout were harvested during the fall, 1986 (Table 18). The indicated decline in the harvest of kokanee may have simply been a result of the earlier spawning run that occurred in 1986. A substantial number of kokanee were harvested in the tailrace during August, a month prior to the initiation of the creel census. The reason for the decline in the rainbow trout harvest is unknown.

Table 17. Monthly catch rates (fish per hour) from the Canyon Ferry tailrace obtained during the fall, 1986.

Month	Number of Anglers	Hours Fished	Rainbow Trout Caught	Kokanee Caught	Brown Trout Caught
September	41	95.8	0.21	0.11	0
October	253	680.3	0.14	0.26	0.02
November	86	193.2	0.38	0.52	0.03
Total	380	969.3	0.19	0.30	0.02

Table 18. Estimated fishing pressure and harvest obtained in the Canyon Ferry tailrace from September 20 through November 28, 1986 with comparable estimates obtained in the fall, 1985.

		HARVEST			
Year	Hours Fished	Kokanee	Average Length	Rainbow Trout	Average Length
1986	6380	1700	19.0	1000	14.7
1985	4000	2280	19.2	2110	12.2

Characteristics of Game Fish Harvested

Length data was obtained from 228 kokanee and 146 rainbow trout harvested in the tailrace. The length frequency distribution for kokanee was bell-shaped and discrete age classes were not distinguishable. Harvested kokanee averaged 19.0 inches in total length and 2.26 pounds in weight. The largest kokanee measured was 23.0 inches in length and 3.78 pounds in weight.

Two distinct age classes were visible in the length frequency distribution for rainbow trout. One age group was distributed around a length of 10.0 inches and another age group was distributed around a length of 16.0 inches. Harvested rainbow trout averaged 14.7 inches in total length and 1.26 pounds in weight.

Fourteen percent of all harvested rainbow trout were age 0+ fish (clipped adipose) that had been planted in the tailrace during July. From examination for spray marks, 13% of the harvest were age 0+ or I+ fish that had been planted in Canyon Ferry Reservoir during May and had passed over the dam during spring runoff or survived passage through the turbines. A majority of these fish (11.6%) were Arlee strain. Four percent of the harvest were age I+ and older

trout (tetracycline marked) that also were originally planted in Canyon Ferry Reservoir and had passed over or through the dam.

Toston Creel Census (1986)

Distribution of Interviews and Angler Characteristics

A total of 403 anglers were interviewed on the Toston section of the Missouri River from September 20 through November 28, 1986. The sampling schedule was stratified to allow for estimates of pressure and harvest. Interviews numbered 99, 236 and 68 in September, October and November, respectively. Thirty-eight percent of the interviews were conducted on weekdays and 62% were conducted on weekends.

A majority of the anglers interviewed were from either Gallatin (25%), Silver Bow (18%), or Deer Lodge (9%) counties. However, out-of-state anglers comprised 20% of all interviews. Nearly all interviews were directed at shore fishermen since creel clerks could interview boat anglers only when they returned to shore. Boat anglers comprised less than 2% of those surveyed. Eighty-seven percent of those surveyed were seeking to catch trout in general. Only 7% of the anglers were fishing specifically for brown trout. Bait was the most popular fishing method, used by 47% of those surveyed, followed by lures (31%), some combination of tackle (14%) and flies (8%).

Composition of Catch, Catch Rates and Harvest

Brown trout, mountain whitefish, and rainbow trout were the most readily caught species in the Toston section of the Missouri River, comprising 57, 23 and 19% of the catch, respectively. A summary of monthly catch rates is presented in Table 19. The overall catch rate for brown trout was 0.28 fish per hour and anglers kept 48.3% of all brown trout landed. This catch rate was similar to the catch rate obtained in 1985 (Lere 1986) and to those obtained in 1982 and 1983 (Rehwinkel 1986). The overall catch rate for mountain whitefish was 0.11 fish per hour. Anglers kept only 13.7% of all mountain whitefish landed. The overall catch rate for rainbow trout was 0.09 fish per hour and anglers kept 58% of all rainbow trout landed.

Table 19. Monthly catch rates (fish per hour) from the Toston section of the Missouri River obtained during the fall, 1986.

Month	Number of Anglers	Hours Fished	Brown Trout Caught	Rainbow Trout Caught	Mountain Whitefish Caught
September	99	286.3	0.21	0.11	0.22
October	236	786.1	0.29	0.10	0.08
November	68	203.6	0.35	0.04	0.10
Total	403	1276.0	0.28	0.09	0.11

rpt/304.2

Estimates of fishing pressure and harvest obtained from the Toston section of the Missouri River during the fall, 1986 are given in Table 20. Anglers expended approximately 4650 hours to harvest 650 brown trout and 260 rainbow trout. Although the creel census conducted in 1986 comprised two weeks more than the census in 1985, fewer numbers of both brown trout and rainbow trout were harvested.

Table 20. Estimated fishing pressure and harvest obtained from the Toston section of the Missouri River from September 20 through November 28, 1986 with comparable estimates[1] obtained in the fall, 1985.

Year	Hours Fished	Brown Trout	Average Length	Rainbow Trout	Average Length
1986	4650	650	17.0	260	15.9
1985	3880	760	17.7	400	17.5

[1] Estimates were obtained from September 28 through November 22, 1985.

Characteristics of Game Fish Harvested

The length frequency distribution for 161 brown trout was bell-shaped and discrete age classes were not distinguishable. Harvested brown trout averaged 17.0 inches in total length and 1.88 pounds in weight. The largest brown measured was 24.1 inches in length and 5.3 pounds in weight. Length data was also gathered from 67 harvested rainbow trout. These fish averaged 15.9 inches in total length and 1.54 pounds in weight.

Canyon Ferry Delta Creel Census

In conjunction with the Toston survey, a creel census also was conducted on the Canyon Ferry delta during the fall, 1986. Historically, the delta area has provided a substantial fall fishery for rainbow trout (Fredenberg 1980). However, this fishery has significantly declined since the early 1980's for unknown reasons. The 1986 creel census indicated anglers expended merely 243 hours to harvest only 64 rainbow trout. These estimates were only slightly greater than estimates obtained in 1985 (Lere 1986).

Preliminary Evaluation of Strains and Mark Retention

Arlee vs Desmet Rainbow

Catchability of the Desmet strain appeared to be less than the Arlee strain during the summer, but appeared to be similar during the winter. These seasonal differences may be due to the suspected pelagic nature of the Desmet strain. As water temperatures warm during the summer, the Desmet rainbow may move to deeper, cooler waters in the limnetic zone making them less susceptible to anglers. Additional vertical gill netting needs to be conducted in Canyon Ferry Reservoir to substantiate this assumption.
A comparison of food habits between the two strains indicates little difference

in diet (Figure 19). Although likely not statistically significant, the Desmet rainbow did appear to feed more exclusively on Cladacerans than the Arlee rainbow. Again, these suspected differences may be due to the more pelagic nature of the Desmet strain.

Empirical growth curves for Arlee and Desmet rainbow planted in Canyon Ferry Reservoir during the spring, 1986 are shown in Figure 20. The Arlee strain exhibited a faster rate of growth than the Desmet strain. Monthly growth rates from May to March averaged 0.83 inches for the Arlee strain and 0.60 inches for the Desmet strain. These growth comparisons, however, were made between unequal aged fish. The Desmet were planted at age I+ while the Arlee were planted at age O+. Even though the two strains were planted at dissimilar ages, the mean total length for both strains was similar by March, averaging 13.0 inches.

Mark Retention

Rainbow trout sampled from creel census activities and gill netting in Canyon Ferry and Holter reservoirs during 1986 were used to evaluate the retention of tetracycline and fluorescent pigment marks in fish. This evaluation was made by comparing the number of rainbow trout marked with tetracycline to the number of fish marked with fluorescent pigment and vice versa. At the time rainbow trout were planted in Canyon Ferry Reservoir, retention of both tetracycline and pigment marks approached 100%. Following planting, mark retention changed very little over a six month sampling period. All planters recovered from the reservoir were found to have retained their tetracycline marks. However, 5% of the fish that were expected to have a double TM were found to have just a single TM. Retention of fluorescent pigment marks also was very good, with approximately 97% of all recovered planters retaining their mark. In Holter Reservoir, mark retention also approached 100% at the time of planting. This percentage did not significantly change over a three month sampling period.

Rainbow Trout Escapement

There is growing evidence that excessive spills through the radial gates on Canyon Ferry Dam may result in a substantial loss of rainbow trout from the reservoir. Escapement of rainbow trout has been previously documented and losses appear to be negatively correlated with the duration and magnitude of these radial gate spills (Rehwinkel 1986). Since Canyon Ferry Reservoir controls seasonal flow patterns, operations of the dam may also have significant impacts on the fishery resources on the two downstream reservoirs. Hill (1973) found substantial numbers of rainbow planters were flushed over Holter Dam as a result of spills associated with spring runoff. Spills normally occur from Holter Dam when releases from Canyon Ferry Reservoir exceed 7,000 cfs. Spills normally occur from Hauser Dam when releases from Canyon Ferry Reservoir exceed 4,300 cfs.

The magnitude and duration of radial gate spills from Canyon Ferry Reservoir during the spring, 1986 were relatively minor when compared to the historical record. During 1986, discharge from Canyon Ferry Reservoir peaked at 13,100 cfs on June 11. Spill in 1986 was limited to a duration of 13 days with a peak radial gate discharge of approximately 7,000 cfs (U.S. Bureau of Reclamation). Historically, the average duration of spills has been about 50 days with a mean radial gate discharge of 7,300 cfs (Rehwinkel 1986). In Hauser and Holter

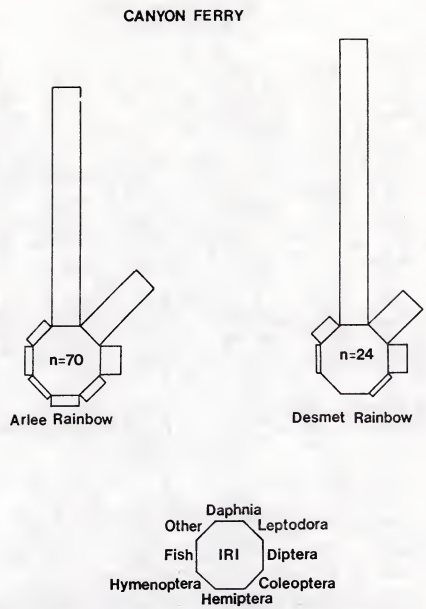


Figure 19 Indices of relative importance (IRI) for food items in the diet of Arlee and Desmet rainbow trout collected from Canyon Ferry Reservoir during 1986.

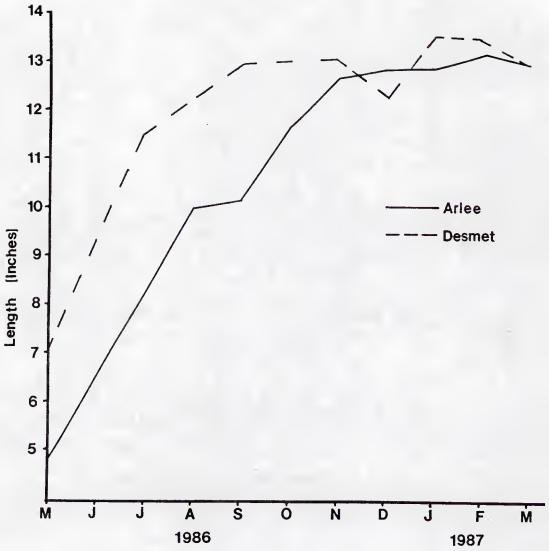


Figure 20 Imperical growth curves of Arlee and Desmet rainbow trout collected from creel census activities and gill netting in Canyon Ferry Reservoir during 1986.

reservoirs, rainbow trout are normally planted following spring runoff in order to avoid these spills.

The tailwaters of Canyon Ferry, Hauser and Holter reservoirs were electrofished during the fall, 1986 to document the occurrence and magnitude of rainbow trout escapement. All rainbow trout of appropriate size collected from the tailwaters were examined for fluorescent pigment marks or for fin clips to identify the reservoir in which they were stocked. Sampling efficiencies were too poor in the Canyon Ferry tailrace to obtain an estimate of the rainbow trout population. However, 58 of 236 juveniles sampled or 25% were pigment marked fish that were originally planted in Canyon Ferry Reservoir. Approximately 4 Arlee were collected for every 1 Desmet. Fish passing over or through Canyon Ferry Dam appeared to remain in the tailwater area since very few of these fish were harvested or gill netted in Hauser Reservoir and none were captured in Holter Reservoir during 1986.

Population estimates for rainbow trout were obtained in the tailwaters of both Hauser and Holter reservoirs. Estimates of the numbers of rainbow trout flushed from Hauser and Holter dams are shown in Table 21. Apparently, the low spring runoff during 1986 flushed very few rainbow trout from the reservoirs. Those that did pass over or through the dams tended to remain in the tailrace areas. Rainbow trout flushed from Hauser Reservoir were not found in Holter Reservoir and planters flushed from Holter Reservoir were mostly found within a one mile segment of Missouri River immediately downstream from Holter Dam. Rainbow trout flushed from Hauser Reservoir passed either over the dam or through the turbines. In Holter Reservoir, planters must have passed through the turbines since the reservoir was stocked following spring spill.

Table 21. Estimated escapement of rainbow trout from Hauser and Holter Reservoirs during 1986 (80% confidence intervals in parentheses).

Tailwater	Section Length (Mi.)	Number of Reservoir Planters in Section	Percent of Reservoir Plants
Hauser	2.86	840[a/] (±470)	0.42
Holter	2.80	1712 (±508)	0.53

a/ Estimate based on 3 recaptures.

MANAGEMENT RECOMMENDATIONS

1. Work toward accomplishing all goals set forth in the long term study plan.

2. Continue mass marking all rainbow trout planted in the reservoir complex utilizing the marking scheme developed for 1986.

3. Continue creel census activities on the reservoir complex.

4. Conduct angler preference survey on Hauser and Holter reservoirs emphasizing opinions on creel limits, night fishing and walleye enhancement in the reservoirs.

5. Identify walleye spawning areas in Holter Reservoir and tag walleye spawners to monitor movements and harvest.

6. Determine extent of competition between brown trout and kokanee for spawning sites in tributaries to Hauser Reservoir, in the Hauser section of the Missouri River, and in the tailrace of Canyon Ferry Reservoir.

7. Estimate recruitment of rainbow trout, brown trout and kokanee fry from all tributaries to the reservoir complex using fry traps.

8. Reduce barriers to spawning migration in selected tributaries by removing beaver dams or by constructing devices to aid passage.

9. Identify tributaries where spawning habitat could be enhanced with the use of improvement structures or additions of spawning gravels.

10. Stock largemouth and/or smallmouth bass into Lake Helena and monitor to evaluate success or failure of the plant.

11. Introduce wild strain rainbow trout into Hauser Reservoir in attempt to establish a self sustaining population.

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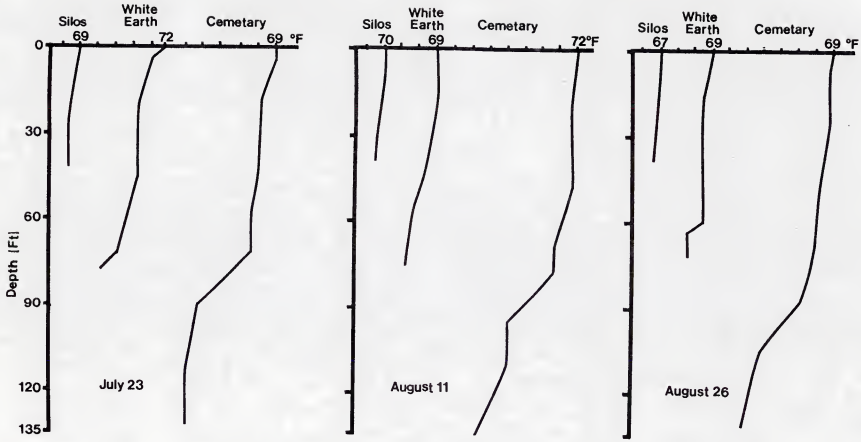
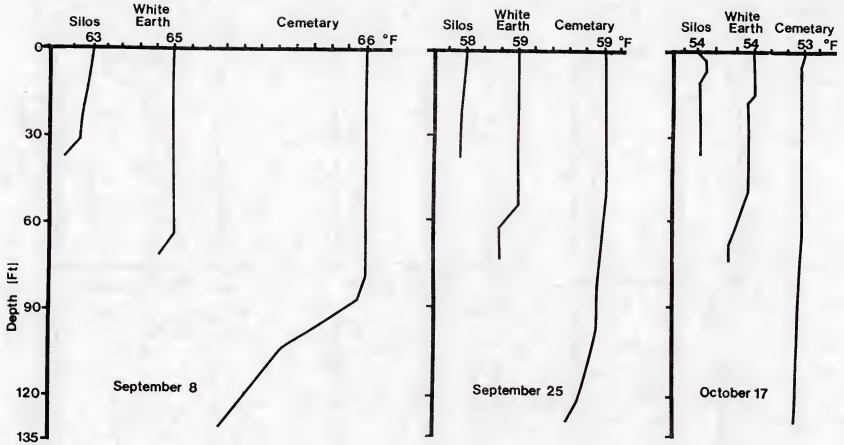
Prepared by: Mark Lere
Date: July, 1986
Waters referred to:

Canyon Ferry Reservoir		17-8832
Hauser Reservoir		17-9056
Holter Reservoir		17-9136
Missouri River	Sec 9	17-4896
	Sec 10A	17-4913
	Sec 10B	17-4914
	Sec 11	17-4928

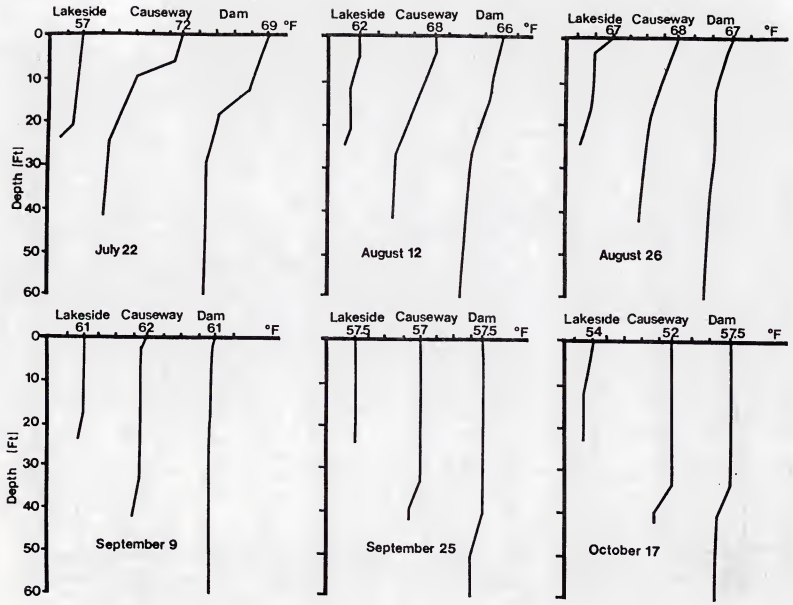
APPENDIX



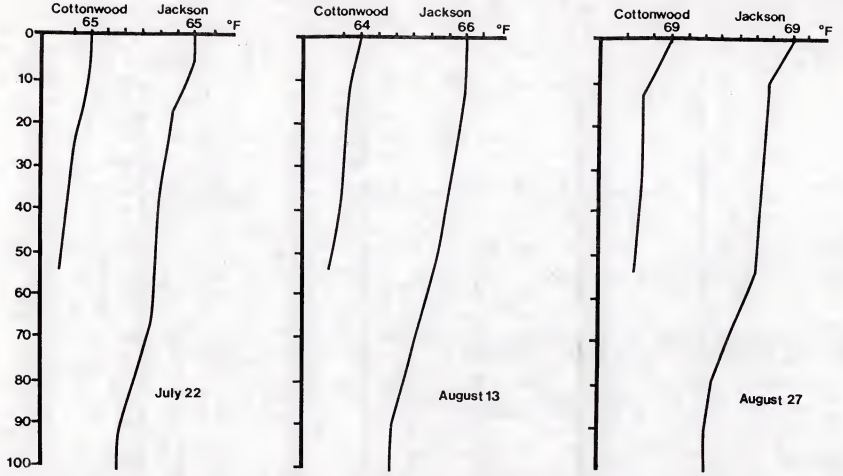
Appendix Figure 1. Profiles of water temperature monitored in Canyon Ferry Reservoir during 1986



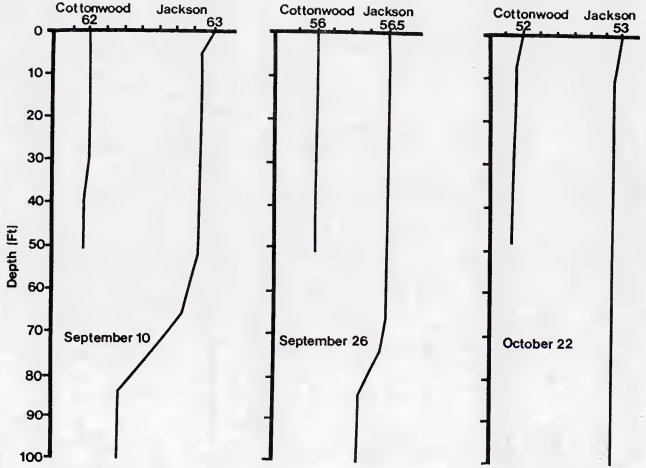
Appendix Figure 2. Profiles of water temperature monitored in Canyon Ferry Reservoir during 1986



Appendix Figure 3. Profiles of water temperature monitored in Hauser Reservoir during 1986



Appendix Figure 4. Profiles of water temperature monitored in Holter Reservoir during 1986



Appendix Figure 5. Profiles of water temperature monitored in Holter Reservoir during 1986

Appendix Table 1. Average catch per net night in floating gill nets set in the three reservoirs during 1986.

Parameter	Canyon Ferry		Hauser		Holter	
	Spring	Fall	Spring	Fall	Spring	Fall
Number of Nets	13	18	9	11	6	7
Ave. catch of[1]:						
Rb	20.9	7.6	14.4	8.0	6.8	13.6
LL	1.8	0.3	0.1	0.6		0.1
Kok			1.4	14.6	0.2	0.9
MWF			0.1	1.1	0.7	0.3
YP	0.2			0.2		
WE					1.3	1.7
LnSu			26.3	0.4	9.2	0.6
WSu			6.9	0.3	6.7	0.1
CP		0.2	0.2		0.3	
UC		0.2	0.2	0.4		

1 Rb = rainbow trout, LL = brown trout, Kok = kokanee, MWF = mountain whitefish, YP = yellow perch, WE = walleye, LnSu = longnose sucker, WSu = white sucker, CP = carp, UC = utah chub

Appendix Table 2. Average catch per net night in sinking nets set in the three reservoirs during 1986.

Parameter	Canyon Ferry	Hauser	Holter
Number of Nets	3	3	6
Ave. catch of[1]:			
Rb	1.5	1.7	4.0
LL	1.0	1.7	0.2
Kok	--	1.7	0.3
MWF	0.3	8.3	1.0
YP	87.7	4.9	20.3
WE	--	--	2.3
LnSu	4.3	123.0	22.0
WSu	56.3	84.7	39.3
Cp	0.3	--	--
Uc	1.7	--	--

1 Rb = rainbow trout, LL = brown trout, Kok = kokanee, MWF = mountain whitefish, YP = yellow perch, WE = walleye, LnSu = longnose sucker, WSu = white sucker, CP = carp, UC = utah chub

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